Department of Energy

Draft Review Plan
for External Independent Review of the

NOvA Project

at the
Fermi National Accelerator Laboratory

June, 2007

Project No: (SC-25-06-1)

Concurrence:

_____ _____
Daniel R. Lehman, Director Date
Office of Project Assessment
Office of Science (SC-1.3)

Approved by:

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Paul Bosco, Director Date
Office of Engineering and Construction Management

_____ _____
Michael Procario Date
NOvA Program Manager
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Office of Science

SECTION 1 – REVIEW OVERVIEW

This review plan provides the requirements for the External Independent Review (EIR) of NUMI Off-Axis Electron Neutrino (ν_e) Appearance (NOvA) Project. The following secti identify the type of review, define the scope and purpose of the review to be performed, id previous reviews that have been performed, and establish the objectives of the review.

This review plan has been prepared consistent with the EIR Process for Office of Science Projects and OECM procedures for conducting EIRs. The Office of Engineering and Construction Management (OECM) will participate in the on-site review portion of the EI The Office of Science and OECM will approve the final EIR review plan and the cost of t prior to authorization of on-site review.

1.1 TYPE OF REVIEW

Prior to a Critical Decision (CD)-2 approval, an EIR is necessary to satisfy the CD-2 (App Performance Baseline) requirements of DOE Order 413.3, *Program and Project Manage for the Acquisition of Capital Assets*. Therefore, the Office of Science has requested an E Team to evaluate the NOvA Project during an on-site review to be held at Fermi National Accelerator Laboratory (FNAL).

The EIR report for this review will be concise and provide a synopsis of the reasonablene the project's readiness for CD-2. The EIR Team will insert recommendations that corresp all findings and selected observations in a Corrective Action Plan shell.

1.2 OBJECTIVES OF REVIEW

The objectives of conducting this EIR are to assist the Office of Engineering and Construc Management (OECM) in reviewing and validating the NOvA Project Performance Baseli to assess the overall status of the project management and control system. This EIR inclu assessment of review elements given in Section 1.3, Scope of Review, below. Generally, elements address the cost, schedule, technical elements, and the project management for t performance baseline. All non-conformances to established requirements will be fully referenced, comparisons to documented benchmarks will be defined and contrasted, and observations involving professional judgment will be noted. The basis for each finding/observation will be identified. Each recommendation will clearly identify the nece action and the proposed benefit to the project. The EIR Team will work to resolve any outstanding issues as part of the On-site Review in order to help ensure the factual accura the draft EIR Report. OECM will facilitate the resolution of factual accuracy issues while site.

1.3 SCOPE OF REVIEW

The NOvA Project is a DOE funded Major-Item-of-Equipment (MIE) project that will upg an existing accelerator-based neutrino beam facility at FNAL, and will construct, fabricate assemble the necessary detector facilities, including a large new detector and detector encl located in Northern Minnesota, for the purpose of conducting neutrino research using the

upgraded neutrino beam. The NOνA Project is primarily DOE MIE funded, and also inclu
some activities supported by a DOE Cooperative Agreement with the University of Minne
for neutrino research, including construction by the University of the detector enclosure bu
to be located in Northern Minnesota (~810 km northwest of FNAL). The scope of this EI
validate for CD-2 the project performance baseline for completing the accelerator and neu
beam upgrades and detector facility construction at FNAL and in Northern Minnesota, to p
reasonable assurance that the project can be successfully executed.

Documentation will be made available to the EIR team via a website or other media upon
in advance of the on-site portion of the review. The EIR Team will review the documenta
prior to the onsite visit in preparation for the on-site review. An Office of Science Indepe
Review Report will include an evaluation of each of the EIR Lines of Inquiry (LOI). Initia
the EIR in coordination and possibly in parallel with the Independent Review will be cons
to the extent practical. The key review elements for this Performance Baseline EIR are des
in the following sections.

i) Work Breakdown Structure

The EIR Team will assess whether the Work Breakdown Structure (WBS) incorporates al
NOνA project work, and whether it represents a reasonable breakdown of the project work
scope. The EIR Team will assess whether the resource loaded schedule is consistent with t
WBS for the project work scope.

ii) Resource Loaded Schedule

OECM and the EIR Team have selected the following NOνA Project WBS elements for d
review; however, during the review the EIR team may choose to review additional, lower
different elements with appropriate justification. For the selected WBS elements in Table
EIR Team will summarize the basis for the cost estimate and schedule duration. The EIR T
will assess the method of estimation and the strengths/ weaknesses of the cost and schedul
estimates for each WBS element reviewed.

In addition, the EIR Team will review the $260M Total Project Cost (TPC) estimate and c
Project Schedule and discuss whether the TPC and schedule are reasonably consistent witl
similar DOE and/or other government/industry type projects. The EIR Team will use the
assessment of cost and schedule contingency and other cost and schedule factors related to
and the project completion schedule. The EIR Team will assess whether the TPC and proj
completion date incorporates all activities necessary to successfully complete the NOνA p

Comment [s1]: These areas need to be discussed and settled on-- or will be determined by EIR after review of documentation??

Table 1. NOvA Project WBS Elements Selected for Focused Review[1]

WBS No. /Activity	Budget (PMB) ($M)	Contingency ($M)	Total Cost ($M)	Duration (days)	Schedule Baseline	CD-4 Complete	Conting (months
2.0 Accelerator & NUMI Upgrades							
Far Detector Building							
2.2 Liquid Scintillator							
2.4 PVC Extrusions							
Total Project Cost							

The above items were selected for detailed review because they constitute a significant po the estimated project cost, span the project requirements, and represent items critical to pr success.

iii) Key Project Cost and Schedule Assumptions

The EIR Team will assess the project's key cost and schedule assumptions and evaluate th reasonableness of these assumptions as related to the quality of the cost and schedule estir

iv) Funding Profile

The DOE funding profile for the TPC is shown in Table 2. The EIR Team will assess whe the resource loaded schedule is consistent with this project funding profile.

Table 1. DOE Funding Profile for NOvA Project

FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY2013	Total Project (
10.3	36	70	69	46	28.1	0.7	260

v) Critical Path

The EIR Team will review the Critical Path schedule and assess whether the Critical Path, is reasonable. The EIR Team will also provide the duration between the CP completion d the project completion date (CD-4) and will assess the reasonableness of the schedule contingency for this type of project.

[1] The baseline values for WBS elements in this table include prior year cost and Other Project Costs applica each element.

vi) Risk Management

The EIR Team will describe the approach used to identify project risks and assess the ade
of the approach used and the personnel to perform the risk analysis. Assess whether all ris
including site specific factors such as availability of contractors, have been quantified bas
the probability of occurrence and consequence, and whether risks have been quantified as
medium, and low; assess whether all appropriate risk mitigation actions have been incorp
into the Performance Baseline to include cost and schedule contingency; and identify the
and schedule contingency and an assessment of whether the basis of contingency is reasor
for this type of project. Finally, the EIR Team will assess whether adequate contingency h
been included in the TPC and Schedule.

vii) Hazard Analysis

The NOvA Project does not include any category 1, 2, 3 or below nuclear facilities as defi
10 CFR 830 subpart B. Hazard Analysis documentation for NOvA Project work has been
prepared and updated using a standardized hazard identification and assessment methodol
safety assessment process is used to address the safety of planned accelerator and detector
operations. The EIR will assess the processes employed for hazard analysis and preliminar
safety assessment as required at the CD-2 stage, including plans for the use of internal and
external safety reviews. The EIR will evaluate whether scope, schedule and cost necessar
safety are sufficiently incorporated into the baseline or provided for through support from
arrangements with the institutions in which NOvA Project work is embedded, such as FNA
the University of Minnesota.

viii) System Functions and Requirements

The EIR Team will assess whether "design to" functions and requirements are reflected in
baseline, including safety, environmental and external requirements such as permits, licen
and regulatory approvals. The EIR Team will evaluate whether system requirements are d
from and consistent with Mission Need. The EIR Team will assess whether the CD-4 activ
i.e. project completion, are clearly identified in the requirements document, and whether t
activities are quantified and measurable (or can otherwise be reasonably determined as
complete).

ix) Preliminary Design, Design Review

The EIR Team will evaluate the adequacy of the project design reviews including whether
review recommendations have been adequately addressed and whether the design is of ade
maturity to establish a baseline.

x) Testing and Acceptance

The EIR Team will assess plans or processes to ensure identification of acceptance,
commissioning and operational system tests required to demonstrate that systems meet des
operational specifications and safety requirements. Key commissioning activities (such as

detector assemblies) will be reviewed to ensure that associated project estimated cost and schedule durations are included for the activities.

1.3.11 Value Management/Value Engineering

The EIR Team will assess the applicability of Value Management/Engineering, and wheth Value Engineering analysis has been performed with results being incorporated into the ba

1.3.12 Project Execution Plan

The EIR Team will review the Project Execution Plan (PEP) and determine if it reflects ar supports the way the project is being managed, is consistent with the other project docume and establishes a plan for successful execution of the project. The EIR Team will also ass whether Key Performance Parameters needed for CD-4 approval of the line item are ident the PEP.

1.3.13 Acquisition Strategy

The EIR Team will review the Acquisition Strategy to determine if it is consistent with the the project is being executed. The Review Team will evaluate any changes from CD-1 tha impact whether the current strategy represents best value to the government.

1.3.14 Integrated Project Team

The EIR Team will assess whether the project management staffing level is appropriate, a determine if appropriate disciplines are included in the Integrated Project Team. The EIR will identify any deficiencies in the Integrated Project Team that could hinder successful execution of the project.

SECTION 2 – BACKGROUND

The CD-0 Mission Need for an Electron Neutrino Appearance experiment was approved b
Director of the Office of Science, Raymond L. Orbach, on November 22, 2005. The propc
NOνA experiment has been selected to meet that mission need, through the execution of tl
NOνA Project. The NOνA experiment will enable study of the pattern of neutrino masses
the details of neutrino mixing by using the Neutrinos at the Main Injector (NuMI) facility
FNAL to provide an intense flux of neutrinos to a large new detector in Northern Minneso
only existing DOE facility capable of producing the neutrino beam required to study the p
of neutrino masses and the details of neutrino mixing is the NuMI facility. The NOνA Pro
will include accelerator upgrade and detector facilities and components at the Fermi Natio
Accelerator Laboratory (FNAL) site, as well as a detector facility located 810 km northwe
FNAL in Northern Minnesota (Ash River).

The DOE Science Office of Project Assessment conducted an Independent Project Reviev
validate NOνA conceptual design and cost range for CD-1 on April 4-6, 2006. The projec
documentation were reviewed and judged to be ready for CD-1. The Conceptual Design R
was judged to be complete and comprehensive and the cost and schedule ranges appropria
Subsequent to this review, there have been a few key developments that have enabled the
project to reach CD-1 approval:

- DOE acceptance of a proposal and selection of the University of Minnesota as a cooperative agreement recipient, which finalizes the alternative selection and the acquisition strategy for construction of the far detector building by the University.

- to achieve reduced NOνA detector cost, and to incorporate other refinements to the preliminary cost and schedule, the detector cost estimate has been revised and the detector mass scaled accordingly.

- given the importance of the planned increase in neutrino intensity to support the pl goals of NOνA and in order to ensure appropriate project management oversight a integration, this collection of accelerator and NUMI upgrades and improvements has been added to the scope of the NOνA project.

CD-1 was approved for the NOνA Project by Raymond L. Orbach on May 11, 2007. A Tc
Project Cost expectation of $260 M has been established for the NOνA Project. The perfo
baseline cost, schedule and scope for CD-2 have been developed to meet this expectation,
consistent with meeting the Mission Need and with the DOE funding guidance and profile
provided. The NOνA CD-2 performance baseline is subject to a DOE Science Independen
Project Review and, in accordance with DOE 413.3A, requires an EIR for performance ba
validation.

2.1 DESCRIPTION OF PROJECT

The NOνA project consists of a near detector located at the FNAL site, a far detector locat northern Minnesota at Ash River, a detector enclosure for the far detector, and FNAL acce and NuMI beamline modifications and upgrades needed to increase the beam power and p the intense flux of neutrinos to the NOνA detectors.

The NOνA project accelerator and beamline upgrade scope consists of new accelerator kic magnet systems; new particle beam injection and extraction lines; additional radio-frequer (RF) particle acceleration stations; transport beamline power supply and quadrupole magn upgrades; and neutrino target system design and cooling modifications.

The NOνA far detector is conceived to be a multiple kiloton tracking calorimeter, approxi 16 m by 16 m by 100 m long. It will be constructed from alternating vertical and horizont of liquid scintillator contained in rigid polyvinyl chloride (PVC) extrusion modules. A Wavelength Shifting (WLS) fiber is inserted into each liquid scintillator cell and terminate pixel of a 32-pixel Avalanche Photo Diode (APD) chip. The APD is followed by front-en electronics that amplify, multiplex, digitize and zero suppresses signals before passing the to the data acquisition system. The NOνA far detector enclosure is an approximately 36,0(square foot space for the NOνA far detector, an assembly area, mechanical/electrical spac office space for a small operations crew.

2.2 STATUS OF PROJECT

Level	Major Milestones	Fiscal Year
1	CD-0 Approve Mission Need	Q1 2006 (A)
1	CD-1 Approve Preliminary Baseline Range	Q3 2007 (A)
1	CD-2 Approve Performance Baseline	Q1 2008
1	CD-3a Approve Start of Construction (early procurements, site prep, foundation)	Q1 2008
1	CD-3b Approve Balance of Construction	Q2 2008
1	CD-4 Project Completion	Q4 2013

SECTION 3 – REVIEW LOGISTICS

3.1 DATES AND LOCATION OF REVIEW

The EIR Team will evaluate the performance of this project during an on-site review at Fe National Accelerator Laboratory.

3.2 REVIEW SCHEDULE

The following schedule is applicable to the overall review sequence.

August 24, 2007	OECM/SC finalization EIR Scope
August 31, 2007	DOE provides Documents for EIR Team Review
September 7, 2007	Draft Review Plan submitted by LMI
September 11, 2007	EIR Review Kick-off at DOE SC Independent Project Review (1st day only, for EIR introductions and to observe first day Plenai sessions in person or by video)
September 14, 2007	Revised Draft Review Plan submitted by LMI
September 21, 2007	Review Plan approved by OECM/SC
September 25-26, 2007	On-Site EIR Review
October 9, 2007	Draft Report and Draft Corrective Action Plan (CAP) Shell Issuec For Factual Accuracy Review and Comment
October 16, 2007	Receive Factual Accuracy Review Comments
October 21, 2007	Final Report, Corrective Action Plan (CAP) Shell, and Comment Resolution Document Issued

Comment [p2]: Is this who is conducting the NOvA EIR for OECM, as was the case for PNNL/PSF?

3.3 PRE-REVIEW TELECONFERENCES AND PREMEETINGS

A review kick-off teleconference between the EIR Team, the Program Manager, and NOv Project personnel will be scheduled as needed, and possibly conducted in conjunction witl DOE SC Independent Project Review.

3.4 INFORMATION AVAILABLE PRIOR TO ON-SITE MEETINGS

The documents provided in preparation of this Project Review are listed in Section 5.1.

3.5 REPORT DISTRIBUTION

This EIR Team will make distribution of the draft and final EIR reports to the distribution provided in Attachment 1.

SECTION 4 – TEAM MEMBERS AND ASSIGNMENTS

Comment [DoE3]: Update per new schedule

DRAFT Assignments for NOvA EIR Team

Topic	Lead Reviewer, Principal Author	Reviewer(s), Contributing A
1. WBS		
2. Resource Loaded Schedule (basis of cost & schedule)		
3. Key Project Cost and Schedule Assumptions		
4. Funding Profile		
5. Critical Path		
6. Risk Management		
7. Hazards Analysis		
8. System Functions and Requirements		
9. Preliminary Design & Design Review		
10. Testing and Acceptance		
11. Value Management/Value Engineering		
12. Project Execution Plan		
13. Acquisition Strategy		
14. Integrated Project Team		
Team Leader		

SECTION 5 – REFERENCES

5.1 AVAILABLE DOCUMENTATION

Documentation will be made available to the EIR team via a secure website by August 31. EIR Team Members should contact Alan Wehmann via email at wehmann@fnal.gov or vi phone at (630) 840-4692 regarding access to the website.

Document Number	Document Title	Doc D
NOVA-DOC-####	NOvA Technical Design Report Performance Baseline-Scope Project WBS WBS Dictionaries Design Criteria Preliminary Design Scope, Cost & Schedule Overview Scope Contingency (?)	Aug 1
NOVA-DOC- Database	Performance Baseline – Schedule Resource Loaded Schedule Summary Schedule Milestone Summary Schedule Contingency Analysis (?) Integrated Project Schedule & Critical Path	Aug 1
NOVA-DOC- Database	Performance Baseline – Cost Estimate NOvA Funding Profile Guidance NOvA Project Level Budget Authority NOvA Project Cost Estimate by WBS NOvA Project Cost Estimate by Control Account Project Contingency Analysis Project Basis of Estimate	Aug 1
NOVA-DOC-616	Contingency Analysis Rules for NOvA	Jan 2(
NOVA-DOC-1321	Procurement Plan for NOvA	May 1
NOVA-DOC-2272	NOvA Risk Management Plan	Jun 2

Document Number	Document Title	Doc D
NOVA-DOC-618	NOvA Hazard Analysis Document	Mar 2
	NOvA Preliminary Safety Assessment Document	
NOVA-DOC-1925	Integrated Safety Management Program for the NOvA Project	Jun 2
NOVA-DOC-1354	NOvA Environmental Assessment	Aug 2
NOVA-DOC-1353	NOvA Quality Management Program	Jun 2
NOVA-DOC-131	NOvA Configuration Management Program	May 2
DOE PEP	Project Execution Plan	Aug 2
DOE AS	Acquisition Strategy	Mar 2
NOVA-DOC-129	Project Management Plan Management, Organization & Responsibilities Technical, Cost & Schedule Baseline Project Controls System Value Management Engineering Design Review	Jun 2

Attachment 1 –EIR Report Distribution

DOE OECM
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